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ABSTRACT

The term "problem-solving" covers three steps of the comprehensive planning process: problem analysis, generation of alternative solutions, and selection of policies or programs from those solutions. After goals have been developed and needs assessed, the problem-solving process begins with identification and definition of the specific nature of the problem to be solved, followed by an analysis of the problem's cause. Once causes are determined, cost-effective alternatives can be sought for solving the problem. The final step is selection of one of these alternatives. This description of the problem-solving process is intended to assist educators facing newly developed situations as well as those engaged in more comprehensive planning. The handbook presents four problem-solving models and two curriculum planning models that can be adapted to the needs of different situations. A brief discussion of techniques applicable to problem analysis and to the generation and selection of alternative solutions concludes the document. (Author/PGD)

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# PROBLEM SOLVING

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# PROBLEM SOLVING IN EDUCATION

*A Planning Handbook for Districts*

No. 4 in a Series of Handbooks on Comprehensive Planning
for Local Education Districts


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June, 1977

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# INTRODUCTION

## WHAT IS IN THE HANDBOOK?

This handbook is divided into seven sections: 1) an introduction, 2) a comprehensive planning overivew, 3) a problem solving overview, 4) problem solving models, 5) comparison of models, 6) problem solving techniques, and 7) appendices.

1) *Planning Overview:* This section explains the comprehensive planning process, the sequence of steps in the process, and a generic planning model.

2) *Problem Solving Overview:* This section explains what problem solving is, why one should do it and what results can be expected. It also provides a brief narrative description of the steps for problem solving.

3) *Models:* This section presents four models for problem solving. Brief descriptions are given for each model, the steps are outlined, and the assumptions underlying each model are given.

4) *Techniques:* This section provides an overview and brief description of possible methods and techniques that can be used in problem solving.

5) *Appendix:* A bibliography and definition of terms.

## HOW TO USE THE HANDBOOK:

This handbook provides general information about the concepts, definitions and steps in problem solving. As a resource it can be utilized for gaining a basic understanding of problem solving. The handbook will *not* give you a detailed "*how to*" approach to problem solving, but will provide the information sources needed to acquire such "how to" techniques and procedures.

## WHO CAN USE THE HANDBOOK:

This handbook can be utilized by people at many levels within a school district. Because it is a resource book and conveys only the concepts and generic steps of the problem solving process, central administration, school principals, classroom teachers and school board members will be able to use the process for solving their own unique problems. However some of the models described within the handbook will be more applicable to some groups than to others.

## WHEN SHOULD YOU START?

When following the generic model of comprehensive planning, problem solving is done after the completion of a needs assessment (See Figure 1). This handbook's treatment of the concepts of problem solving includes problem analysis, generation of alternatives, and the selection of policies and/or programs.

Realistically though, problems occur all the time and not within the set framework of a general model. Usually referred to as crises or brush fires, the problems can be dealt with in the same methodological manner as outlined by the models in this handbook. Thus, the problem solving process can be applied at any level and at any time as long as you know what is to be accomplished or there are indications that an objective is not being achieved.

# PLANNING OVERVIEW

## A. WHAT IS COMPREHENSIVE PLANNING?

Educational planning has not always been logical. Frequently educators have created programs, introduced curricula, developed instructional methods, and prepared budgets without first determining what their plans were intended to achieve. A comprehensive planning process attempts to correct this serious defect by answering these questions: Where have we been? Where are we now? Where are we going? Where do we want to go? How can we get there? How will we know when we get there? How will we monitor the process? A comprehensive planning process will help to design, implement and evaluate programs tailored to meet the identified school needs and to fulfill the school goals.

## B. GENERAL STEPS IN A PLANNING PROCESS

### *Commitment To Begin Comprehensive Planning*

This procedure is usually initiated by one or more staff members or an administrator who introduces the idea to the district. The school board must then either formally reject or accept the idea of adopting a comprehensive planning process.

### *Goal Development*

This step defines the ends toward which efforts are directed. These ends or goals should express the general desired outcomes of the planning process. This stage can come before or after a needs assessment.

### *Needs Assessment*

This stage determines district and school needs. A need can be defined as the difference between "what is" and "what should be," or lack of something requisite, desirable, or useful. Needs should be related to the learner. All other needs, such as institutional ones, should ultimately relate to the learner needs.

## *Problem Analysis*

This stage involves examination of the reasons for the discrepancy between the goals and the needs, identifying the elements of the problem, their causal relationship, the relative impact of each, and the degree to which each can be altered.

## *Generation Of Alternatives*

From this examination of the problem flows the development of various alternative solutions. These alternative methods are analyzed in terms of effectiveness (quality), cost, time, consequences on other goals, impact (quantity), political feasibility, and other side effects.

## *Selection Of Policies and/or Programs*

Based upon the analysis of the various alternatives in the preceding step, one of the alternatives is chosen as the policy and/or program for implementation. In this stage, the decision-makers can include the same group involved in earlier stages or a person or group not previously involved in the process.

## *Implementation*

At this point, the selected program is developed into a plan of operation including program goals and objectives and carried out by the administrative mechanism. The people who planned the program need not be involved in its implementation, but the program design should provide for feedback from the implementors in order to give an on-going measure of how well the program is meeting the goals and objectives.

## *Evaluation*

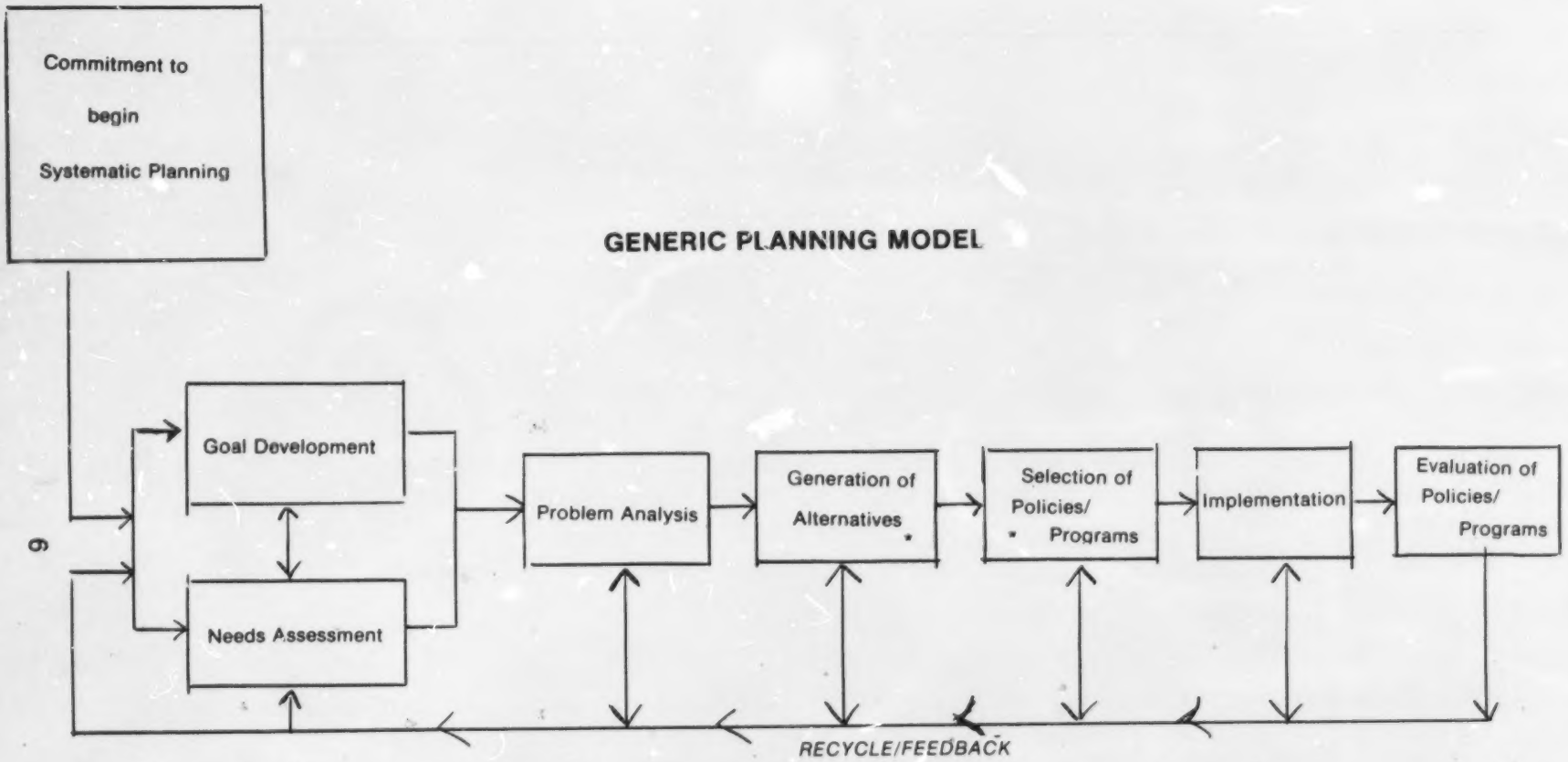
This step examines the success of the implemented program in achieving the designated goals and objectives. Feedback from this stage provides the basis for modifying all the steps of the process in order to improve the attainment of the goals.

## *Recycle*

The entire process is repeated because in a rapidly changing society, goals and needs must be continually redefined to reflect new conditions and new priorities.

A more complete description of the Comprehensive Planning Model can be found in the first handbook of this series entitled *Comprehensive Planning in Education.* Handbook No. 3, *Needs Assessment in Education,* contains more information about the needs assessment stage.

## GENERIC PLANNING MODEL

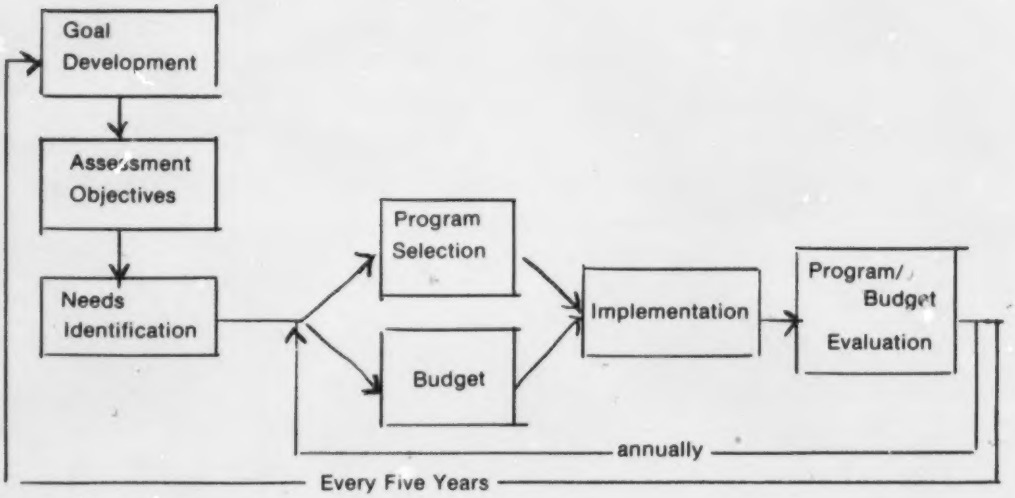



Developed by
Bureau of Planning
Divisions of Research, Planning
and Evaluation
New Jersey Department of Education
December, 1973

*Described in Handbook No. 4, Problem Solving in Education.

Figure 1

## GENERAL PLANNING MODEL FOR T & E*




### CONCERNS TO BE CONSIDERED IN EACH STEP

1. Context 2. Communications 3. Involvement 4. Priorities 5. Data Needs

6. Management Process 7. Evaluation

*Compare to the Planning Handbook Generic Model on preceding page.

## *What Is Problem Solving?*

This handbook, *Problem Solving in Education*, covers three steps of the comprehensive planning process; Problem Analysis, Generation of Alternatives, and Selection of Policies and/or Programs (See Figure 1). After goals have been developed and needs identified, the problem solving process begins with an examination of possible causes for the identified discrepancy between a goal or objective and the current situation, i.e., a need. The problem solving process consists of five steps, each dependent upon the previous step. The first three steps refer to the Problem Analysis phase of comprehensive planning. The last two steps are usually referred to as the Decision-Making phase. The steps of problem solving are:

**Problem Analysis:**

1) *Problem Identification:* more fully identifies and documents with relevant observations, values, data and policies the problem or need (to be taken from the needs assessment phase of planning.

2) *Problem Definition:* A clear statement of *what is* as compared to *what should be* about a situation. A definition should include distinctions between *what is* and *what is not* the problem and a statement of what the measurable end product should be as a result of solving the problem.

3) *Analysis of Cause:* Determining the structure, emphasis, and interrelationships in information about a problem in order to find possible causes. It is finding the changes that have occurred within a situation and therefore causing the problem.

**Decision-Making:**

4) *Generation Of Alternatives:* Searching and identifying a variety of cost effective options for solving a problem and meeting a desired outcome.

5) *Selection Of Alternatives:* This is the final decision-making step of problem solving. It involves screening the options and choosing the best one.

There are many models for problem solving and a variety of words to describe the steps of problem solving. The intent of this publication is to summarize and put into a commonly used sequence the overall problem solving process derived from a variety of sources.

## *Why Do Problem Solving?*

The primary purpose of problem solving is to find the most likely causes of a problem and decide on the "best" course of action for alleviating the problem. By implementing this process it is possible to minimize waste, inefficiency, confusion over objectives, and avoid the selection of an inappropriate solution to the problem. Because the process enables problem solvers to look at the factors surrounding a problem, to define the problem, and to distinguish causes from symptoms, it increases the probability of addressing a problem with an appropriate solution.

## *What Are The Expected Outcomes Of The Problem Solving Process?*

As in all planning, there is a purpose to problem solving and certain results can be expected. Listed below are the outcomes/products to be attained as the problem solving process is implemented.

1. A statement of the goal or objective for improvement.

2. A statement that indicates a problem exists including facts, assumptions, and values clearly identifying and documenting the problem.

3. A statement indicating *what the problem is* and *what it is not.*

4. A problem definition statement including a desired measurable outcome.

5. A statement of most likely causes.

6. A list of criteria for selecting the "best" solution.

7. A list describing th alternative policies or programs.

8. The Decision: Which alternative(s) will be implemented.

9. Objective outcome statement for the alternative selected.

## *The Steps Of Problem Solving*

This section provides a more detailed discussion of the steps involved in problem solving. The purpose is *not* to give a *"how to"* approach to problem solving, but to try and convey the basic concepts behind each step and to give a general description of what is usually involved in each step of the process. It is assumed that a difference or discrepancy between what should be and what is, i.e., a need, has been identified as a result of the needs assessment phase of the comprehensive planning process. The task now is to find out why there is a gap and plan to implement a solution to reduce or eliminate that gap and hence solve the problem. It may be helpful to clarify the definition of a problem: "a deviation from what is desired, for which causes must be determined and action planned to eliminate the deviation."

## STEP 1
## *Problem Identification*

Recognizing and documenting a deviation from a standard or describing the gap between what is and what should be (identified in the needs assessment) is the first step of problem solving. The task is to identify the problem as precisely as possible. This involves not only reviewing the data collected during the needs assessment, but also further delineating and augmenting your information with data that explains what, where, when, who, and how much, or to what extent, about the problem. Observations and historical trends are helpful in identifying and clarifying the situation and should be used if available. All of this information is used as subsequent steps to define and analyze the problem. The more specific and exact you are in describing the situation and thereby identifying the problem, the more probable the chances of finding a solution for the problem.

To exemplify what is meant by identifying a problem, you can take the case of a tennis pro who has the objective of winning a particular tournament. Unfortunately, every year the pro loses the match. The gap or problem can be identified as not winning the tournament. But this statement provides very little

precise information about the identified problem. What are the circumstances surrounding the problem of not winning? What additional information should the pro have about the problem?

To aid in the understanding of problem identification, knowing a few basic concepts would be appropriate. These concepts are general and are applicable to all cases: 1) there is a stated expected standard of performance against which to compare the actual performance; 2) a problem is a deviation from that standard of performance; and 3) a deviation from a standard must be precisely defined with specific information. For instance, how many times has he lost the tournament? In what round? Against which players? By what scores? On what type of courts?, etc. Having this information identifies the problem.

## STEP 2

## *Problem Definition*

To define a problem it is suggested that the information be organized and summarized into one or two statements. In the previous step, problem identification, information was collected to identify and clarify the factors affecting a particular situation. The present task is to use that information to specify as precisely as possible, in a statement, the identified problem. Using the example of the tennis pro the problem could be defined (partially) as the tennis pro has lost 10 out of 10 matches in the last five years, in the last set, in the invitational tournaments, played on clay courts and primarily against opponent tennis pro B.

In some models, defining a problem means specifying it so precisely that a conceptual boundary is drawn around it enabling the problem solver to make distinctions between what is and is not the problem. These distinctions are done along four dimensions: What, where, when, and to what extent. For another approach to problem definition see the PLANS model in Figure 2.

# PROBLEM DEFINITION FORM

Figure 2

**A. The Mission**

**B. The Problem**

**C. Parameters of the Problem**

1. Locus (boundaries):
2. Level (grades, etc.):
3. Target population (detailed characteristics):

4. Limitations (constraints)

   a. Time (date to be completed)

   b. Budget (fiscal resources available, or in kind):

   c.

   d.

   e.

**D. Detailed Specifications** (Product Performance Requirements)

| WHAT WILL BE DONE (How much? How many? etc.) | HOW CAN WE VERIFY (Detail measures, panels, etc.) |
|---|---|
| 1. | 1. |
| 2. | 2. |
| 3. | 3. |
| 4. | 4. |
| 5. | 5. |

12

**E. Process Performance Requirements** (Caution: Do not specify a solution.)

| | |
|---|---|
| | |

**F. Concise Narrative Summary** (Mission Objective):

**G. Enabling Law, Policy, Regulations, etc.** (Cite action by whom and date):

**H. Volunteered Solutions** ("How" Bank; Catharsis Record):

To summarize, based on all the information gathered, categorized, and interpreted you should be able to define the problem. This statement should include 1) what the problem is; 2) where it is; 3) who is affected; 4) to what extent; 5) a list of what is and is not the problem; and 6) what is the goal for improvement?

## STEP 3

## *Analysis Of Cause*

When analyzing a problem you are looking for the possible cause or causes of the problem. One should consider who or what is causing the problem; what clues does all the information give about possible causes; what changes have taken place in a particular situation to have caused the problem. Answering these questions and others requires a careful analysis and interpretation of all the information available. For example, when considering changes one must ask how long a problem condition has existed. There could be events that are identified as changes, that call attention to a problem, which have nothing to do with causing the problem condition. The tendency at this stage, which must be resisted, is to move too quickly to conclusions before analyzing the data. Similarly one must guard against accepting too readily common or familiar causes for a problem. Identifying symptoms of the problems and not the causes, is another pitfall to be avoided.

Basic to analyzing the problem is the requirement to identify the change that has taken place. Where a change has occurred it is an indication of a possible cause of a problem. What is different about the situation now that wasn't there before the problem appeared? This may be a difficult question to answer for many problems currently facing education, because these changes have long histories and may be outside of the school's control. For this reason it is important to specify the problem as precisely as possible and to keep the boundaries of the problem situation fairly narrow.

## STEP 4

## *Generation Of Alternatives*

Generating Alternatives and the Selection of Policies and/or Programs, together, constitute the decision-making phase of problem solving. Decision-making implies that you know where you want to end up (goal or objective for improvement decided upon in the problem definition) and there are criteria for judging the alternatives so that a decision can be made about a possible solution.

The first step, Generation of Alternatives, involves a large amount of information collection to explore the possible ways to meet a desired outcome. There are techniques and methods that can be employed to identify alternatives. For example, creative brainstorming (see Techniques section) can be used to tap the knowledge and experience of the staff involved in the planning and implementation of the alternative. Outside experts can be consulted, the literature and research can be reviewed, and programs currently available can be reviewed. At this stage of the process the appropriateness of the alternative should not be restricted by cost, time, potential problems of implementation, and lack of personnel. At the start, any idea should be considered.

As an aid to generating alternatives it is helpful to consider such questions as "What is to be accomplished?", "What problem is being corrected?" (taken from the problem definition and analysis), "Where are we trying to go?", "What is our goal for improvement?" and "How will the situation be different as a result of implementing a program?" Answering these questions will provide a direction for the generation of alternatives and will also avoid confusion over what needs to be done or where you want to end up. It may also be helpful to look at any objectives that have already been produced.

## STEP 5

## *Selection Of Policies And/Or Programs*

There are a number of possible techniques for selecting the best solution. No technique is infallible. It takes objectivity, precision, good judgement, insight, and experience to assist decision-makers in selecting an appropriate alternative. The first step for selection is to list criteria on which to rate and compare the alternatives. Criteria might include:

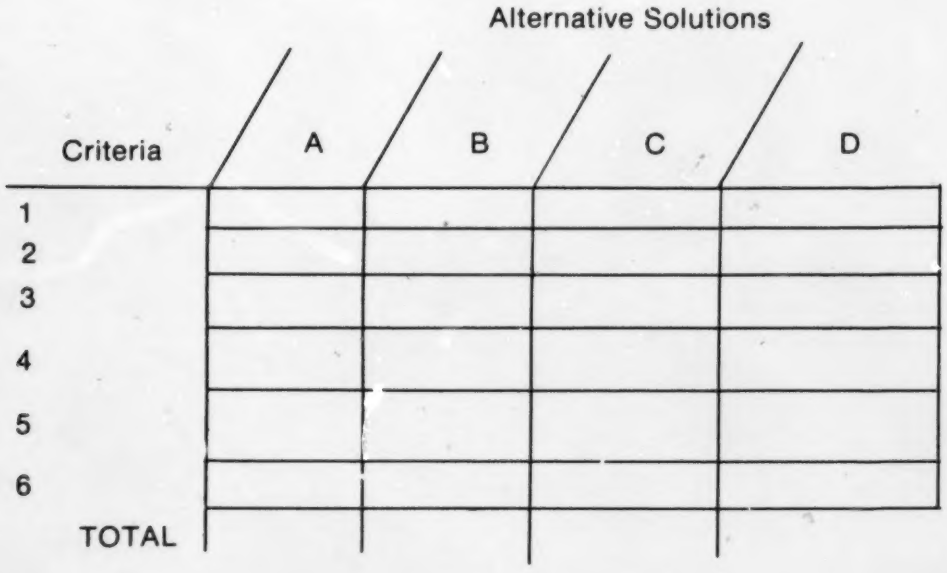
1) the impact upon other goals, objectives, policies
2) political feasibility
3) feasibility of implementation
4) availability of resources
5) cost-benefit
6) cost-effectiveness
7) time
8) relevance to the problem it addresses
9) potential for achieving the goal or objective

Other criteria to address more specifically an educational alternative might include:

1) adaptability to present school programs
2) training time required
3) target audience
4) emphasis of program
5) materials geared to all levels
6) implementation of multiple teaching strategies

One way of structuring or recording individual or group ratings would be to use the matrix in Figure 3.

**Figure 3**




Rate each alternative on a scale from 1-5 for each criteria - 1 being a low rating and 5 the highest or most favorable rating

Again, to compare alternatives, objectives for each solution or alternative should be well defined in measurable terms. The alternatives should be assigned ratings for each applicable criteria. By comparing the ratings, and applying professional judgement an alternative can be selected for implementation.

There are obviously a variety of ways criteria can be drawn up to fit a variety of problems. In fact a new list of criteria may have to be produced each time a significant problem is addressed. Hopefully some of the broad categories will remain consistent and specifics can be added to fit the situation.

The sequence of steps presented as the problem analysis and decision-making stages of the generic planning model lead to Program Implementation. The Program Implementation stage will be covered in Handbook No. 5. The next section of this handbook reviews several problem solving models.

# MODELS

## INTRODUCTION

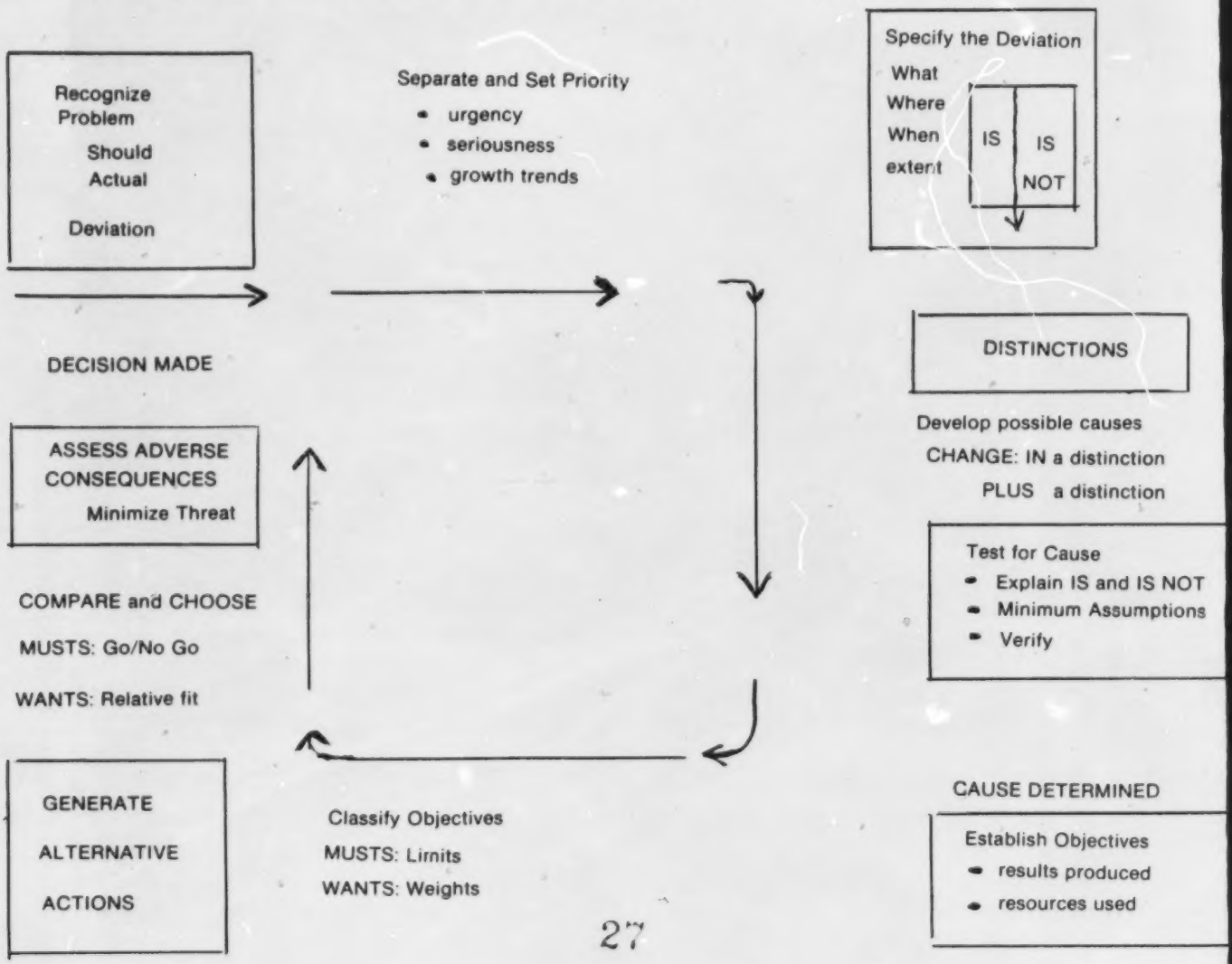
This section provides a brief summation of four problem solving models. What follows is a narrative description of each model, the assumptions behind each model, and the specific steps involved in each model. The intent of this section is to familiarize the reader with the four models of problem solving, not to provide complete instructions on the implementation of each model.

## MODELS

### *Problem Solving and Decision-Making*

The Kepner and Tregoe model for problem solving (see figure 4) provides a systematic and logical approach to thinking through a problem, and using good judgment and experience to solve the problem. In their book, Kepner and Tregoe base their problem solving model on two concepts: (1) deviation — there is an expected standard of performance and a problem is a deviation from that standard; and (2) causation — the cause of a problem is always a change that has taken place to produce that unwanted effect. The model consists of a series of steps and techniques that help a problem-solver: (1) identify and define precisely a deviation; (2) find the distinction between *what is* and *what is not* the problem; (3) identify relevant changes that have taken place, and (4) determine the most likely cause. The second part of the model sets forth the steps and techniques of decision-making (the generation and selection of alternatives). For an example of the Kepner and Tregoe model of problem solving see Techniques for analyzing distinctions and changes in the Techniques section.

**Figure 4** Kepner and Tregoe Model for Problem Solving and Decision Making



## *What Are The Problem Solving Steps?*

The Kepner and Tregoe model for problem solving involves the following steps:

1) *Recognize the problem:* identify the deviation between what is and what should be.

2) *Specify the deviation:* identify the distinctions between what is and what is not the problem along four dimensions: what, where, and to what extent.

3) *Develop possible causes:* identify the change that has taken place; this involves identifying and eliminating all factors which produce an effect shared by both the "is" and "is not" sides of the problem.

4) *Determine the cause:* the factor shows a distinction between what is and what is not the problem, (i.e. a factor that is *not* common to both the "is" and "is not" sides of the problem.)

5) *Establish objectives:* what is to be achieved by action taken.

6) *Set criteria for selecting alternative:* feasibility, does it achieve objectives, etc.

7) *Generate alternatives:* possible ways to achieve the objectives set.

8) *Compare and choose:* weight criteria and use judgement to choose best solution.

9) *Make the decision:* decide on alternative to implement.

## *How Are Problems Identified?*

To identify a problem using the Kepner and Tregoe model there must be a deviation from a standard or a perception that the deviation exists. This assumes

that standards or objectives have been set and the current situation is known and specified so that a deviation can be recognized. A person can use this information to identify the deviation or problem and begin defining the specifics of the problem.

## *How Are Alternatives Identified and Selected?*

This phase of the model identifies a course of action that must be decided upon and implemented in order to solve the problem. To begin, a very specific objective for each alternative must be stated and used as a standard of comparison between the various ways of solving the problem. The objective must tell you what the alternative is expected to achieve, how well it is expected to achieve, how long it is expected to take, and what is the target population. This standard information about each alternative forms the basis of comparison. The development of alternatives in this model is usually done by the problem-solver on the basis of his or her experience and knowledge. The development of alternatives involves a careful search for specific actions that will perform a precise function. Once alternatives are identified they must be judged against the relevant objectives and other specific weighted criteria in order to select the best course of action.

## *How Can The Model Be Used?*

The Kepner and Tregoe model has been designed with business management in mind, and is oriented towards crisis problem solving. However, the authors emphasize that once a person has gone through the process a few times it becomes a part of the every day routine for solving and preventing problems. The purpose is to develop a way of thinking through problems logically and sequentially. The model can be used as part of the generic planning model, or to handle brush fires, or even long-term and persistent problems, because the concepts and the steps remain the same. Although the model is written for business managers, the process and systematic search and use of information to solve a problem is applicable to all levels of an educational organization and for anyone who wants to try and solve a problem (administrators, teachers and students).

## *Where Can You Acquire More Information?*

The model itself can be found in the book by Charles Kepner and Benjamin B. Tregoe, *The Rational Manager A Systematic Approach to Problem Solving and Decision-Making*, McGraw-Hill, New York, 1965.

## *PLANS: Providing Local Agencies with New Strategies*

*PLANS*, developed by the Worldwide Educational and Research Institute in Salt Lake City, provides a basic model for educational planning and problem solving. The orientation of the model is basic comprehensive planning. It assumes that an outcome or knowing where you want to go has been stated, and that a solution to the problem must be found. The process does not look for the cause of a problem, but analyzes how to get from where you are to where you want to go. It defines a problem as "needing to systematically identify all of the elements of a situation requiring goal attainment without a well-established way to secure such attainment." The process takes a need and rewrites it as a problem statement, which is then defined as a system with a specific outcome. The next steps of the model assist in identifying all the elements that must be completed to reach an objective. Alternative methods are then considered and the best method is chosen for implementation.

## *What Are The Problem Solving Steps (see figure 5)*

1) *Identify the Problem:* a problem is derived from a need - it is the gap between what is and what should be: in this case a problem exists when there is a goal to be attained and no well defined way of attaining it.

2) *Define the Problem:* consists of a concise problem statement, mission, constraints, performance requirements, and mission objectives.

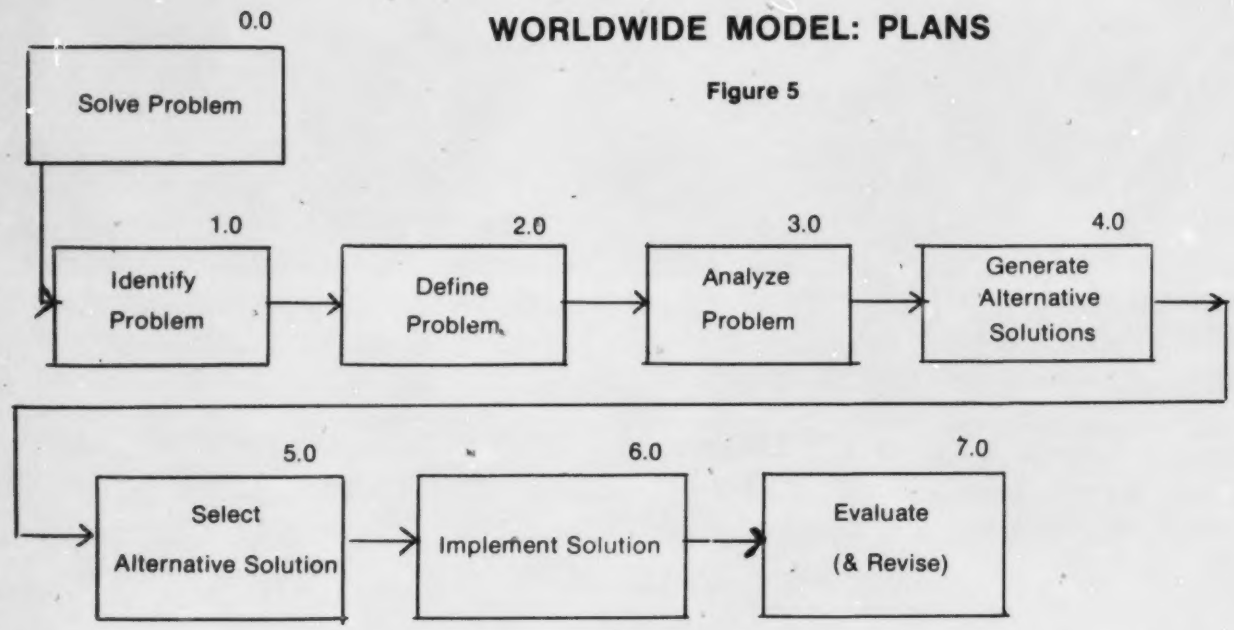
3) *Analyze the Problem:* breaking a problem into its component parts or functions and tasks; this is also referred to as systems analysis.

4) *Generate alternative solutions:* through a number of techniques such as brain-storming, a number of possible programs are suggested for reaching the same objective.

5) *Select "best" alternative:* a systematic evaluation of all alternatives in terms of objectives and constraints involving techniques such as cost-effectiveness or cost-benefit analysis.

*Major Concept:*

There are seven distinct milestones in the problem-solving process. These can be portrayed in flowchart form as follows:




**WORLDWIDE MODEL: PLANS**

**Figure 5**

All of the concepts and tools of the systems approach to educational planning and problem solving are directly related to these milestones.

PLANS: Worldwide Education and Research Institute, Salt Lake City, Utah, 1971

## *How Are Problems Identified?*

In the Worldwide model problems are identified from need statements developed during the needs assessment. For example, a problem statement given by the Worldwide model concerns a student living at home, but plans to be attending a college four miles away. The problem is transportation to and from the college. At the first step, problem identification, he identifies his need for transportation. In reviewing his situation he sees the transportation to and from college as a subproblem to getting a college education. But the immediate problem is identified as transportation to and from college. The problem is then further documented by identifying relevant facts, related to the need or expressed concern, such as there is no public transportation, he cannot afford a car, he has a bike, etc.

## *How Are Alternatives Identified and Selected?*

Alternatives are generated through workshop sessions which encourage the creative production of alternative solutions. This is done through techniques such as brainstorming, trial and error, or a combination of these and other techniques. The second step, selecting the alternative is done after weighting each of the alternatives by a set of criteria in conjunction with judgment to select the best solution. Both cost-effectiveness and cost-benefit analysis, as techniques for analyzing the alternatives, are explained and used in the workshop material.

## *How Can The Model Be Used?*

This model fits closely with the generic comprehensive planning model. (See figures 1 and 5). It does not look for causes or explain why a problem might exist but instead identifies what is needed to achieve an objective. A major reason for this orientation to problem solving is how a problem is defined in the model: "finding a way to attain a goal". The process requires identifying facts and data surrounding a situation or problem, stating a mission objective to eliminate that need, and then identifying the tasks for achieving the objective identified. It assists in delineating all the steps necessary to achieve an outcome and then finding the best way to do it.

## *Where Can You Acquire More Information?*

The Worldwide Education Research Institute is located at 2315 Stringham Avenue, Salt Lake City, Utah 84109. The looseleaf material of the model includes leader instructions, worksheets, definitions, and explanations of all steps of the process:

## *RUPS: Research Utilizing Problem Solving*

The RUPS model for problem solving is designed for use by the classroom teacher, school or district administrators. The RUPS model has two purposes: 1) working toward improvements in school through problem solving processes and research utilization processes; and 2) increasing team work skills.

## *What Are The Problem Solving Steps:*

1) *Identifying the Problem:* using four guidelines a) Who is affected? b) Who is causing it? c) What kind of problem is it? d)What is the goal of improvement?

2) *Using research about the classroom/school:* through the use of research findings on classroom conditions the problem statements are rewritten, taking the research into consideration.

3) *Diagnosis using the Force Field analysis:* the problem is diagnosed by setting a goal to be achieved and then identifying all the forces working against achievement and all the forces working for achievement.

4) *Gathering Data:* The force field analysis may reveal a number of areas that require more data for clarification. This step of the process focuses on a number of ways for teachers to gather information about the classroom or the school.

5) *Analyzing the Data:* this step involves providing and using the skills necessary for finding the major results from any data collected and analyzing those results.

6) *Deriving Action Alternatives and their Implications:* based on the research and through brainstorming techniques, alternative actions are derived and the implications of those actions considered.

7) *Planning for action:* includes deciding on resources needed, resources available, and identifying influencing organizational and community conditions. Steps for implementing the plan are also included.

## *How Are Problems Identified?*

Participants write a problem statement based on what they perceive the problem to be. This statement must answer the four guidelines given previously in the process: "Who is affected?", "Who is causing it?", "What kind of problem is it?",

and "What is the goal of improvement?" As the process proceeds, the problem can be modified or changed completely based on inputs of new information.

## *How Are Alternatives Identified And Selected?*

The participants use their research findings and brainstorming techniques for generating alternative actions. Through the use of a set of criteria you can determine the feasibility of each alternative and choose a solution for implementation (See figure 6).

## *How Can The Model Be Used?*

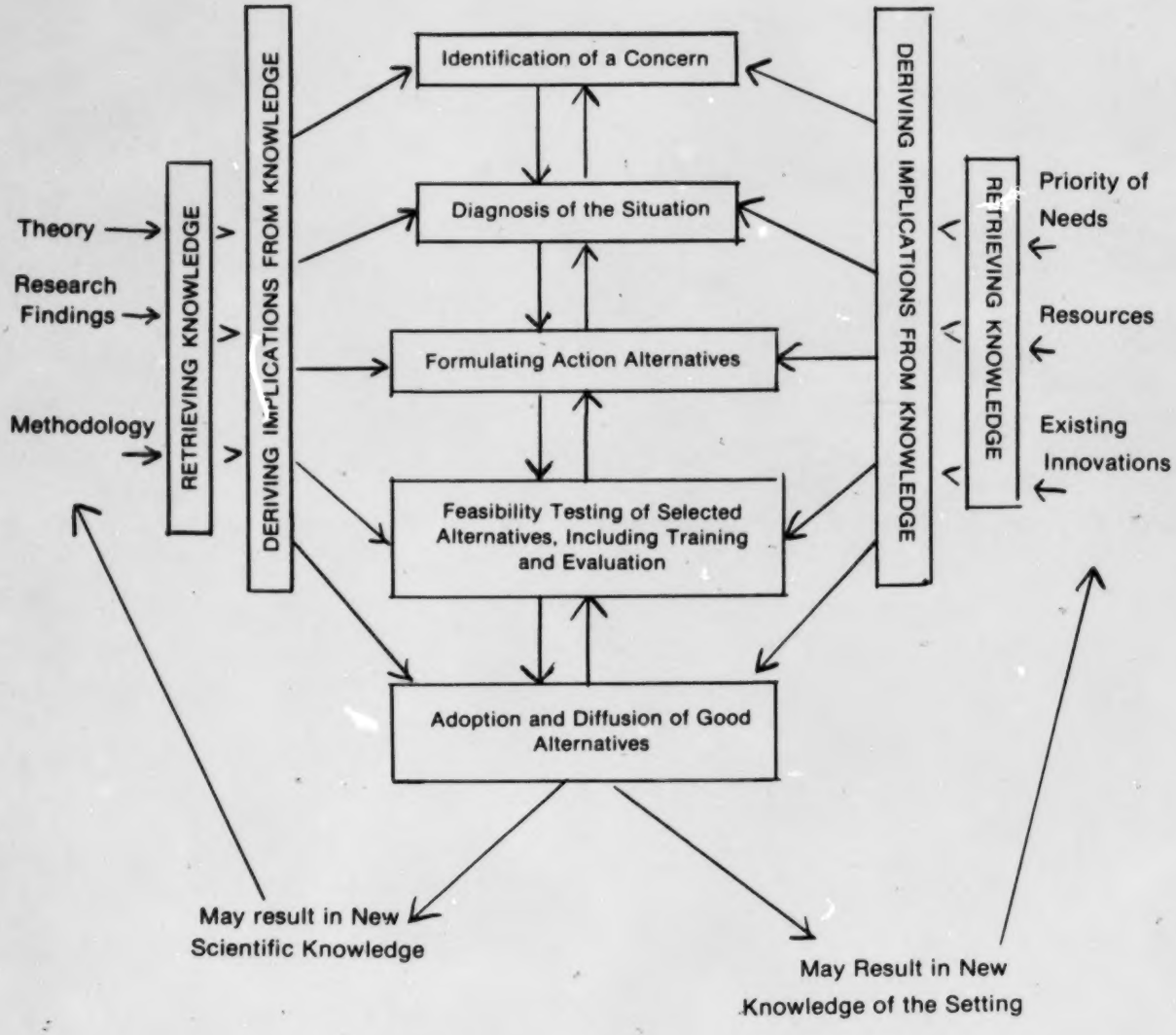
The model provides simulated activities of the problem solving process for educators with the focus on helping to solve classroom, school and district problems. The model can be used as part of the generic planning process or by itself if immediate problems need attention before district-wide or school-wide goals setting and needs assessment have been completed.

## *Where Can You Acquire More Information?*

The RUPS model can be obtained from Northwest Regional Educational Laboratory, Lindsay Building, 710 S.W. Second Avenue, Portland, Oregon 97204.

## RESEARCH UTILIZING PROBLEM SOLVING MODEL*

**Figure 6**




*Jung, Charles and Ronald Lippitt. "Utilization of Scientific Knowledge for Change in Education." *Theory Into Practice* 5:25-29; February 1966.

## *The Problem Solving School (I/D/E/A)*

The Institute for Development of Educational Activities Inc., located in Dayton, Ohio, designed a model for problem solving based on the conviction that a "self-directed program might be developed which could make a lasting contribution to school change." The model is designed to carry out problem solving on two levels: the school level, concerning problems affecting the entire faculty; and the classroom level, concerning problems of individual teachers. The model strongly emphasizes team building and consensus on needs and problems in the school through the exchange of ideas and the discussion of issues and problems.

## *What Are The Problem Solving Steps?*

1) *Identifying the problem:* this involves a full faculty meeting to discuss and identify the problem;

2) *Clarifying the problem:* a force field analysis technique is used and data about the situation is gathered; information is categorized as facilitating or blocking.

3) *Exploring alternative strategies:* through a discussion and brainstorming techniques alternatives are generated and selected; strategies are identified as to their appropriateness for dealing with the blocking forces already determined.

## *How Are Problems Identified?*

Problems are identified by faculty members, through group discussion and coming to consensus.

## *How Are Alternatives Identified And Selected?*

Again, faculty members generate alternatives through brainstorming techniques and decide upon the best solution.

## *How Can You Use This Model?*

This model is designed for use by the classroom teacher and for solving problems on an individual or group level, with a focus on team building and

working together to identify and solve problems. It can be used by itself or in conjunction with the generic planning model.

## *Where Can You Acquire More Information?*

Information and workshop materials can be acquired by writing to I/D/E/A, P.O. Box 628, Far Hills, Dayton, Ohio 45419.

## *Selecting A Curriculum Program: Balancing Requirements And Costs*

This model presents a process designed to help school district personnel select a new curriculum program on the basis of cost and whatever program requirements are important to them. The most desirable approach to program selection would be a "cost effectiveness" approach — an approach which would enable school personnel to determine the effectiveness of different programs at varying levels of resource commitment, thereby permitting them to choose the least costly program for a specified effectiveness level. Unfortunately, information on program effectiveness at different resource levels is not yet available. Consequently, the process presented is one that can be used to consider both program cost and effectiveness insofar as it is feasible to do so—given the current state of the art.

The process presented here entails: determining the requirements for a new program; identifying at least three suitable instructional programs; establishing very specific criteria for selecting a program; gathering cost and requirements information on each program under consideration; analyzing and comparing programs; selecting the most appropriate program; and documenting the selection process.

## *What Are The Steps Of The Model?*

**Step 1 — Identifying Screening Criteria and Suitable Programs**

This step utlizes worksheets for summarizing the results of previous planning efforts. It also provides brief directions on how to complete the following activities, if they were not completed during prior planning efforts: (1) identifying information which suggests that a new program is needed; (2) analyzing the strengths and weaknesses of the current curriculum program; (3) specifying screening criteria to be used in identifying suitable programs; (4) locating available programs, and (5) identifying from three to seven curriculum programs that meet the screening criteria established.

**Step 2 — Establishing Selection Criteria**

This step presents an approach which can be followed to develop a set of five to ten specific selection criteria.

**Step 3 — Analyzing Alternative Program**

This step describes how to gather detailed cost and requirements information on each of the alternative curriculum programs being considered.

**Step 4 — Comparing Alternatives and Selecting a Program**

This step shows how the programs being analyzed can be compared in terms of the extent to which they satisfy each of the selection criteria. The results of these comparisons provide the basis for the final selection of a specific program.

## *How Can The Model Be Used?*

Although this selection process can be carried out by one person, it is strongly recommended that it be undertaken by a group of approxmiately six professional staff—teachers or curriculum coordinators (for the curriculum area involved), building principals, and central office administrators. If a group effort is planned, one person, usually referred to as the Project Manager, should be assigned to coordinate the activities of the entire curriculum selection project. This person usually leads group discussions at key points in the selection process. The Project Manager's Guide provides time and cost estimates which can be used in planning the project and checklists for monitoring the completion of the activities discussed in each of the four steps. It is recommended that the Project Manager read the entire model and obtain the support of all school district personnel who will have a voice in the final decision before initiating this curriculum selection project.

## *Where Can You Get More Information?*

*Selecting a Curriculum Program: Balancing Requirements and Costs* by Ball, R.; Marvin, M.; and Temkin, S. can be secured from Research for Better Schools, 1700 Market St., Philadelphia, Pa.

## Curriculum and Instruction: Planning Improvement

This model is designed to help coordinate a school system's improvement effort. It shows how to work with a planning group from the school system, using *Curriculum and Instruction: Planning Improvement* to decide how curriculum and instruction should be modified in order to meet existing student needs.

*Curriculum and Instruction: Planning Improvement* aims to avoid problems arising from:

- poor definition of student needs
- vague requirements for improvement
- premature and inappropriate selection of means of improvement
- failure to involve those who will be asked to support or implement new programs and practices.

Specifically, it shows the planning group how to:

- develop a clear and substantial statement of student needs
- establish a comprhensive set of requirements for the improvement of curriculum and/or instruction
- search for and locate means of improvement which match their requirements
- communicate with various audiences in the school system about their plans and findings

## *What Are The Steps Of The Model?*

**Step 1** Developing the Need Definition

a) clarifying student performance
b) establishing performance standards
c) specifying student populations expected to meet performance standards
d) documenting current student performance
e) reviewing the need definition

**Step 2** Establishing Improvement Requirements

a) analyzing curriculum content
b) analyzing curriculum organization
c) analyzing the instructional approach
d) analyzing the support system
e) refining improvement requirements

**Step 3** Planning and Conducting the Search
- a) determining search boundaries
- b) specifying kinds of information to be collected
- c) developing the search report form
- d) selecting search tools
- e) conducting the search

## *How Can This Model Be Used?*

This model can be used by most school personnel who might be given the responsibility for organizing school improvements. Additional assistance is provided by time estimates needed for the steps of the model. These steps are then integrated into the normal school calendar. The focus of the model can be program oriented or school wide.

## *Where Can You Obtain More Information?*

This model developed by Sharon Tumulty can be obtained from Research for Better Schools, 1700 Market Street, Philadelphia, Pa.

# TECHNIQUES

# *INTRODUCTION*

This section presents a variety of techniques that can be used by groups or individuals in the problem solving process. Part A gives an overview of techniques that can be used for Problem Analysis and Part B describes those techniques useful in Decision-Making. The section includes only a few of the many possible techniques that can be used in problem solving.

**A. Problem Analysis Phase (Problem Idenfication, Problem Definition, and Analyzing the Problem)**

1. *Force Field Analysis*

Force Field Analysis (see figure 7) is used to assist in the identification of positive and negative forces impacting on a problem. Derived from the social-psychology of Levin, it is basically a diagnostic technique for analyzing a problem. In the problem solving models, after defining a problem you have problem statement, and a measurable end result. At this point the force field analysis is used to provide a process and format for identifying all the forces that work towards achievement of a goal and all the forces that work against achievement of a goal. There are three guidelines that should be remembered in doing a force field analysis: 1) be as specific as possible about each force written down; 2) state discrete forces rather than global ones; 3) think of categories of forces that might otherwise have been overlooked.

EXAMPLE (taken from RUPS workshop materials)

Problem Statement by teacher: "The group this year just can't seem to get along. It isn't a matter of intelligence, they just don't seem to want to work. For some reason or other, they're dragging their heels all the way and I don't know how to lead them. I want to do something, but I don't know where to begin. What can I do?

Improvement Goal: To help some of the children in my classroom become more active learners. (See figure 6 for a force field analysis of this problem)

2. *Technique for analyzing distinctions and changes: What is and What is not the problem.*

This technique, unique to the Kepner and Tregoe model, is the key technique to their problem solving process. During the problem definition step, specifics are listed describing what the problem is and what it is not, given in precise terms. The primary purpose of the technique is to identify and specify the facts that precisely describe the deviation and that directly affect the object (person, class,

etc.), and to identify those facts closely related to the deviation but not affecting the object. This information is filled in under the *is* and *is not* columns of Figure 8. The more specific the information about what is and what is not the problem, the easier it is to find the distinctions and therefore the closer one can get to finding the cause.

Once the specification sheet has been filled in, the next task is to find the distinctions. This is done by searching out what separates the factors, what makes them *unlike*. The distinctions appear when things and conditions related to a deviation on the IS side are seen to be in some way completely distinct from the things and conditions arranged on the IS NOT side of the specification.

> "The cause of any problem is always a change that has had limited effects, producing effects in some places but not in others. Such a change is limited to areas of distinction or has occurred to features or factors that distinguish the IS of the problem. Therefore, to find which change produced a given effect, it is most efficient to look only for those changes that are limited to the distinctions found in the specification." (Kepner and Tregoe 1965)

It is from the separating aid of distinctions that the changes, and hence the cause of the problem are identified. For example, consider the problem of basic skills achievement for class I. The data shows that 35% of the students are getting only 40% of the items right in the reading skills part of the statewide assessment tests. The teacher would like to bring the level up to 65% of the items right by the end of the year. To achieve this objective it is necessary to find out the possible causes for the low achievement. Using the Specification sheet from Kepner and Tregoe model the problem could be analyzed as follows:

| PROBLEM | IS | IS NOT |
|---|---|---|
| **WHAT:** | Reading; word recognition synonyms/antonyms | Study skills, content clues |
| **WHERE:** | In reading group C and D using text x and y | In reading group E and F using text x and z |
| **WHEN:** | Low scores over past two years using text z and y | Unique to this year |
| **TO WHAT EXTENT:** | Analyze test data for number of items missed and which ones: which students | All other items on the test<br>All students in the class |

Under each item listed more information could be provided to help determine the cause but this is an example of how it can be started. In reviewing the information given and asking "what is the DISTINCTION of the word IS?" the following could be said: there is a problem in the reading skill of word recognition and specifically with antonyms for students in group C and D and who are using text y. The problem did not start this year and is occuring with students (list names).

These are the factors that appear to be *unlike* the factors from the *is not* side. At this point you could hypothesize possible causes such as students in Group C and D are using a text that does not emphasize word recognition skills. But to look for a cause at this time is probably too risky and you should take the distinguishing factors (identified thus far and gather more specific information about them such as historical data on what the students in Group C and D did in reading over the past two years; how much time the groups spend on certain skill drills, how much time is spent on reading by each of the groups, etc. The object is to become as precise as possible and to use your judgement for interpreting the information.

**B. Decision-Making Phase (Generating and Selecting Alternatives)**

1. *Brainstorming*

Brainstorming has been defined in the PLANS model as "A" form of group dynamics designed to encourage creative and imaginative thinking about solutions to a problem by means of an uninhibited exchange of ideas". The principle behind brainstorming is to be creative and accept all ideas to start — no idea is a bad idea. Alex Osborn in his book *Applied Imagination*, described the framework necessary for brainstorming as follows:

> In setting up a creative procedure, initial analysis is important in order to create a "framework". First make sure of clearly defined objectives.
>
> These steps will necessarily vary with circumstances; but, in all cases, one of the first is to use the imagination to construct, out of the data supplied by memory and observation, a framework of ideas that will serve as a foundation for further work. Thus the writer uses imagination to outline the composition he will write...

After all possible ideas have been generated, then weighted criteria are applied to each alternative to establish the feasibility of the idea.

2. *Cost-effective Analysis*

Cost-effectiveness is one technique that can be used in selecting the best alternative. This technique should be used in conjunction with other criteria such as dollars available, time, needed personnel, political feasibility, degree of difficulty in implementing, and whether or not it achieves the objective and solves the problem. The cost-effectiveness analysis relates the cost of a particular activity with the effectiveness of attaining relevant goals and objectives. The process allows a decision-maker to choose from among feasible alternatives on the basis of least cost and greatest effectiveness. Two approaches are generally used. One can either minimize dollar costs subject to some goals and objectives or one can maximize some physical measure of output subject to a budget constraint. Taken from the PLANS workshop material. Figure 9 gives a simplified version of doing cost-effectiveness.

**Force Field Analysis by teacher: (RUPS 1973)** **Figure 7**

Problem: Children do not seem to want to learn.

| *Forces for Solving Problem* | *Forces Against Solving Problems* |
|---|---|
| I want to be more active | Some children act like they don't care about learning |
| I see myself as responsible to help them to be active learners | Some seem to block others from learning |
| They are an intelligent group | I don't have enough information to know where to begin |
| Some of the children are active learners | I am not as strict as some of the teachers the children have had |
| I have good rapport with some | Some seem to fight me most of the way |
| The testing program indicates no one in the group has unusually low intelligence | |

**Figure 8 Specification Sheet**
(Kepner and Tregoe 1965)

| | Deviation | | | |
|---|---|---|---|---|
| What: Deviation Object | IS | IS NOT | What is DISTINCTION of the IS? | Any CHANGE in this? |
| Where: On object observed | | | | |
| When: | | | | |
| EXTENT How much How many | | | | |
| Possible causes for test: | | | | |

A SIMPLIFIED ILLUSTRATION OF A COST-EFFECTIVENESS ANALYSIS OF ALTERNATIVE READING PROGRAM STRATEGIES

**Figure 9**

| | Alternative Program Or Activity | Total Program cost increase | Effectiveness: Estimated % Improvement of Test Scores | Effectiveness: Cost Rated |
|---|---|---|---|---|
| A | Increased Time | $100,000 | 10 | 1.0 $(\frac{10}{100,000})$ |
| B | Decrease Class Size | 50,000 | 20 | 4.0 |
| C | Improve Materials | 20,000 | 10 | 5.0 |
| D | Hire Specialists | 40,000 | 20 | 5.0 |
| E | Improve Methods | 30,000 | 20 | 6.7 |
| F | Start Earlier | 10,000 | 10 | 10.0 |
| G | Buy Technological Aids | 100,000 | 40 | 4.0 |
| H | Initiate Individualized Instruction | 30,000 | 10 | 3.3 |
| I | For Special Classes for the Disadvantaged | 40,000 | 2 | 0.5 |
| 0 | Existing Program Cost | 400,000 | BASELINE | |

RECOMMENDATION FOR AN EXPENDITURE OF $40,000: To Maximize Effectiveness

$$F + 1/3\ D + 1/2\ E + 1/12\ C\ (Certif) = \frac{10}{10,000} + \frac{6.7}{13,333} + \frac{10}{15,000} + \frac{10}{1,667} =$$

$$\frac{27.7}{40,000} = \text{Effectiveness/cost ratio of } 7$$

Note: Cost increases and estimated % improvement of test scores were based on a hypothetical illustration by Peat, Marwick, Mitchel and Co., Conceptual Design for PPBS in California School Districts (L.A.: PMM & Co., Mar. '69)

# APPENDICES

# APPENDIX A

## *Definitions*

**Analysis of Cause:** A process or procedure for analyzing collected information in order to find the cause of a problem.

**Brainstorming:** A form of group dynamics designed to encourage creative and imaginative thinking about solutions to a problem by means of an uninhibited exchange of ideas.

**Cost-Benefit Analysis:** A technique used to compare benefits of a particular program with the costs subject to specified constraints. It focuses on individual as well as social benefits and costs and for spill-over effects. It usually deals with economic benefits as compared with non-economic objectives.

**Cost-Effectiveness Analysis:** A technique used to determine the greatest effectiveness for any given cost or to yield a required or chosen degree of effectiveness for the least cost.

**Criteria:** An objective, standard, rule or test by which a judgment of something can be formed.

**Deviation:** A difference between an expected standard and what is actually happening.

**Distinction:** Finding the facts or conditions that distinguish one fact or category (what is) from another fact or category (what is not).

**Force Field Analysis:** Techniques used in problem solving to analyze and diagnose a problem in terms of forces working for and against achievement of a goal.

**Problem:** A deviation from what is desired, for which a cause must be determined and an action taken to eliminate the deviation.

**Problem Definition:** A clear statement of what is as compared to what should be done about a situation.

**Problem Identification:** A process or procedure for systematically identifying and documenting with facts, data, and information surrounding a perceived problem.

# APPENDIX B

## *MODELS*

1. *From Goals to Action* Fresno County Department of Education, 2314 Mariposa Street, Fresno, California, 93721

2. *Plans: Basic Program in Educational Planning and Problem Solving* Worldwide Education and Research Institute, 2315 Stringham Avenue, Salt Lake City, Utah 84109. Single copies $25, ten or more copies $15 each.

3. The Problem Solving School, inservice training material include a handbook of guidelines and a series of five booklets for classroom level use. Institute for Development of Educational Activities, Inc. I/D/E/A, Suite 300, 5335 Far Hills Avenue, Dayton, Ohio 45429.

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## APPENDIX C

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